SPACE SHUTTLE/ FOOD SYSTEM STUDY

FINAL REPORT

REQUIREMENTS DOCUMENT

CONTRACT NAS 9-13138

MODIFICATIONS 3S, 4C and 5S

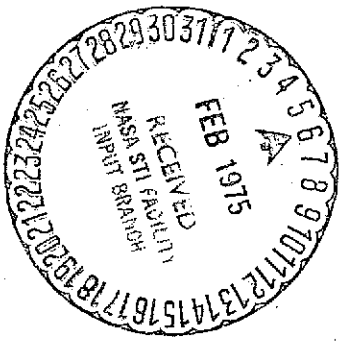
prepared for

NATIONAL AERONAUTICS and SPACE ADMINISTRATION
Manned Spacecraft Center
Houston, Texas 77058

Contract NAS9-13138

Prepared by

THE PILLSBURY CO.



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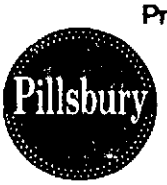

THE PILLSBURY COMPANY
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TABLES

1.0 INTRODUCTION

For the follow on effort, a need for a design specification was identified. This requirements Document represents the current data as available from the Shuttle contractor and does not account for future design changes.

2.0 SCOPE

Procurement of the Space Shuttle Food Galley can be accomplished after the galley requirements are established and the Specification is documented.

This Document establishes the performance requirements of the Space Shuttle Galley

3.0 REQUIREMENTS

3.1 Performance

3.1.1 Operational Requirements

The galley subsystem shall provide a centralized location for performing all food related functions (except dining) within the Orbiter. The galley shall provide for food stowage (food to be GFE), trash handling and stowage, hot and cold water dispensers, oven, wipes, preparation equipment and accessories, utensils and dining trays. The galley shall be desighed to permit minimum meal preparation and clean-up time in zero gravity and ease of servicing, maintenance and Orbiter removal in one-gravity.

3.1.1.1 Overall System Requirements

3.1.1.1.1 Food Capacity Requirement

The food requirement shall be based on a 42 man-day capability plus 16 man-days of contingency food. The galley shall be sized to accomodate this quantity of food for a nominal 7 man crew. The food will be comprised of rehydratable items, beverages, and ready-to-eat (RTE) items in bar form, and condiments. Contingency food will be Air Force type emergency rations.

3.1.1.1.2 Food Preparation

Crew meals will consist of combinations of hot and/or cold rehydratables and beverages, plus RTE bars and will be prepared by a single crew member. A basic meal plan of 8 beverages per man day, 4 RTE's per man day and 7 rehydratable items per man day shall be prepared with the balance of items prepared as snacks twice a day. A planned overage of food items may be used either as snacks, additional items per meal, or as replacement for potential spoilage, damage or spills occurring during handling and preparation.

The rehydratable food items provide the basic entree and side dishes for each meal, supplemented by the RTE's and beverages. The hot water source shall provide the required rehydration water in quantity and temperature to prepare a crew meal. After rehydration the hot food items shall be maintained at a palatable temperature by a galley holding oven, until the balance of the meal preparation is complete. The hot food serving temperature shall be 135-145° F.

3.1.1.1.3 Meal Assembly

A meal assembly area, integral or adjacent to the galley, shall be utilized to enable the crew member to assemble meal components to the individual serving trays. Total meals for up to 7 crew members shall be prepared and served at one time.

3.1.1.1.4 Work Areas

The galley shall contain integral work areas to support snack or beverage preparation requirements during in-between meal periods, and to support basic meal assembly procedures.

3.1.1.2 Galley Subsystem Requirements

3.1.1.2.1 Food Storage

3.1.1.2.1.1 Food Primary Packaging

a) Beverages

The proposed beverage drink package will be essentially a modified Apollo type pack, consisting of a hermetically sealed flexible plastic container with an integral septum material that is punctured for water insertion. Warm or cold water may be utilized as required. A pair of scissors is required to open the beverage pack. When folded and stowed, each beverage pack is essentially rectangular with dimensions of 3.5 x 5.0 x 0.28 inches overall.

b) Rehydratables

The rehydratable food items are packaged in a combination stowage/dining pack as developed under NASA contract NAS 9-13138. This package consists of a semi-rigid

saucer-like base to which is affixed a flexible plastic cover folded and sealed to the base. Within the base is a septum material for inserting a water dispensing probe for hot or cold rehydration. The package is cut open at the top and forms a dish for dining. The package is vacuum packed, and when stowed all rehydratables are 4 x 4 x 1.03 inches overall. After use the package will be re-closed for waste stowage.

c) Ready-to-Eat (RTE) Bars

The RTE's are food items requiring no preparation and may be dry or intermediate moisture bars, bites or wafers. The bars are formed into an essentially rectangular shape and when stowed are 2 x 4 x 0.55 inches overall, including a plastic overwrap package.

d) Condiments

Liquid form condiments (salt, pepper, spices, sauces, catsup and mustard) will be provided in individual fin-sealed pouches of flexible plastic laminates capable of being cut open and individually dispersed on food. The condiment package when stowed is 3.5 x 1.5 x 0.25 inches overall.

e) Contingency Food

The contingency food provides emergency rations in the event of an on-orbit failure resulting in mission abort. The Air Force emergency ration can with basic dimensions of 2.12 x 3.25 x 3.75 will be used.

3.1.1.2.1.2 Food Quantities and Weights

The following quantities of food items shall be stowed within the galley:

Item	Pkg. Qty. (Total)	Packaged Wt. (Each)
Beverages	357	1.73 oz.
Rehydratables	308	2.44 oz.
RTE	217	1.90 oz.
Condiments		
Catsup	32	0.4 oz.
Mustard	21	0.4 oz.
Salt	108	0.1 oz.
Pepper	63	0.1 oz.
Spices	63	0.1 oz.
Sauces	45	0.4 oz.
Contigency	16	305 gm.

3.1.1.2.1.3 Food Accessibility

Meal menus will be pre-selected by the crew on the ground. Food shall be stored on the Orbiter such that the components for each meal can be readily accessed and identified. Removal of a food package shall not be encumbered by other packages. Removal sequence shall be in accordance with the pre-selected and pre-packaged menu plan.

3.1.1.2.2 Trays

Provisions for 7 trays and their stowage shall be made in the galley. The trays shall be sized to accomodate the following

3.1.1.2.2 Trays (cont'd)

items.

- Rehydratable food packages	3
- RTE's	2
- Beverage packages	2
- Personal wipe	1
- Condiments	3
- Utensils	3
- Waste Stabilizer Packet	1

The trays shall interface with the dining station.

3.1.1.2.3 Water System.

Potable water will be delivered to the galley from ship supply. Ambient water at a temperature range of 55°F. - 120°F. will be delivered at a flow rate of 60#/hr. and 8-17 psig, and shall be heated by galley equipment to a temperature of TBS to achieve optimum food rehydration and to meet the requirements of 3.1.1.1.2. Chilled water at 45 - 55°F. will be delivered to the galley at a flow rate of 60#/hr. and 8-17 psig, and shall be used for drinking water and cold food or beverage rehydration. Water supplied to the galley will contain a maximum free gas concentration of 0.1% at 37°C.

3.1.1.2.3.1 Flow Demand

Continuous flow demands for the galley water system are dependent on the particular food/beverage package to be rehydrated and the number of packages involved at any one meal. There is also a requirement for drinks at any time between regular meals. The continuous flow demand will not exceed 8 ounces (maximum requirement for any one food/beverage package).

a) Maximum Meal Demand

Maximum demand for water at any one meal is based on the accumulated intermittent demands for the individual food/beverage packages required to make up a maximum meal for a seven man crew. The accumulated time is that required from initial water dispensed to last water dispensed for that particular meal.

- Hot Water

Total Quantity for Meal	15.5#
Accumulated Time for Water Demand	24 min.

- Chilled Water

Total Quantity for Meal	17#
Accumulated Time for Water Demand	23 min.

b) Nominal Daily Demand

The nominal daily demand for both hot and chilled water is based on typical menu plans derived under NASA Contract NAS9-13138 and sized for a seven-man crew as follows:

- Hot Water	23#
- Chilled Water	18#

3.1.1.2.3.2 Water Heater

The water heater shall be sized to provide for a continuous flow of 60#/hr. with ambient inlet water replacing heated water as withdrawn for rehydration of food and/or beverages.

The heater shall be provided with a temperature gauge to provide visual assurance to the crewman of heater operation condition. The gauge shall be located adjacent to the hot water dispenser.

3.1.1.2.3.3 Water Dispensers

The hot and chilled water shall be dispensed by crewman actuated devices that mate with the insertion septum device on the food, drink or beverage package. The dispensers shall be capable of dispensing up to 10 $\pm$ 0.1 ounces of water at any one usage, adjustable in increments of 1/2 ounce. The dispenser shall have visual indication of the amount of water to be dispensed. The dispenser probe shall be designed to puncture the septum material of the rehydratable package without damage to the probe or package and flow the pre-selected quantity of water. The dispenser design shall preclude leaking water to the cabin at all times. The dispensers shall minimize water temperature excursion between uses.

3.1.1.2.4 Drink Cup

Each crewman shall be provided with a reusable drink cup to mate with the water dispenser probe in 3.1.1.2.3.3. The cup shall

3.1.1.2.4 Drink Cup (cont'd)

have a capacity of 10 ounces and shall contain a reusable filling septum and a drink nozzle capable of use in zero gravity.

3.1.1.2.5 Oven

The galley oven shall be an electrically heated chamber that maintains food at TBS ° F. The oven shall accomodate hot rehydratable food for seven crewmen.

3.1.1.2.5.1 Oven Pre-Heat

The oven shall be pre-heated from ambient to operating temperature in a maximum of 10 minutes.

3.1.1.2.5.2 Controls

The oven temperature shall be controlled at TBS ° F. $\pm$ 2 ° F. An ON-OFF switch shall clearly indicate its selected position.

3.1.1.2.5.3 Instrumentation

The oven shall be provided with a temperature gauge to provide visual assurance to the crewman of oven operating conditions.

3.1.1.2.5.4 External Temperature

Oven surface accessible to the crew shall not exceed 113° F.

3.1.1.2.6 Utensils

Utensils shall be provided for each crewmember. Seven sets of full-size utensils each consisting of a spoon, fork and scissors shall be stowed within the galley. The utensils shall be capable

3.1.1.2.6 Utensils (cont'd)

of being attached to the tray exterior during zero gravity usage. Preparation and handling utensils shall be provided as required.

3.1.1.2.7 Waste

3.1.1.2.7.1 Waste Storage

The galley shall provide for disinfecting and storage of all trash generated by galley operations. Trash will consist of used food, beverage and RTE packages, wipes, condiment packages and waste stabilizer tablet packages. As a minimum, the galley shall provide for storage of trash at an equivalent as-stowed volume ratio for beverage and rehydratable packages and at a 1/4 to 1 as-stowed volume ratio for RTE, wipe, condiment and waste stabilizer packages. Sufficient trash volume shall be provided for miscellaneous and loose trash items, as may be generated during snack periods or from food overage quantities.

3.1.1.2.7.2 Waste Stabilization

To inhibit bacterial growth and odors in consumed and/or partially consumed food packages, a waste stabilization tablet similar to that used on Apollo will be added to each package. The tablets shall be individually sealed in a multiple quantity packet to service a food tray. The galley shall provide stowage for the waste stabilization packets.

3.1.1.2.8 Wipes

The galley subsystem shall store individually wrapped wet wipes for personal use and for general galley clean-up.

3.1.1.2.8.1 Personal Wipes

Personal wipes will be in packets 2.2" x 3" x 0.12" and weigh 0.013 pounds each. The galley shall provide storage for 210 wipes.

3.1.1.2.8.2 Galley Wipes

Galley wipes will be in packets 6" x 3" x 0.16" and weigh 0.075 pounds each. The galley shall provide storage for 48 wipes.

3.1.1.2.9 Electrical Power Characteristics

The electrical power characteristics will be in accordance with Rockwell specification MF-0004-002. The galley subsystem maximum power consumption shall be 2.0 kw.

3.1.1.2.10 Instrumentation

Instrumentation, signal conditioning, and precision power supply shall be provided for user readout. Operational instrumentation and development flight instrumentation interfaces shall be in accordance with Rockwell specification MF-0004-006. As a minimum the following development flight instrumentation shall be provided.

a) Oven switch ON-OFF

b) Oven temperature

c) Hot water temperature

d) Hot water heater switch ON-OFF

3.1.2 Performance Requirements

The following subparagraphs specify the applicable requirements of the Shuttle Galley in terms of reliability, maintainability, life requirements, transportability, natural and induced environments, human engineering and safety. These performance requirements shall apply during the useful life of the end item.

3.1.2.1 Reliability

Reliability activity shall be planned and developed in conjunction with other program elements. Reliability functions shall be an integral part of design, development, and operational program phases and shall include the evaluation of hardware reliability through analysis, review and assessment. The hardware supplier shall be responsible for the planning, management, and effective execution of the reliability effort. The galley design shall meet the requirements of NHB 5800.4(1D) as modified by this document.

3.1.2.1.1 Redundancy

The galley subsystem shall be designed such that any single failure shall not result in an uncontrollable release of water to the cabin.

3.1.2.1.2 Failure Deterrent and Detection

The galley subsystem design shall incorporate the following:

a) Separation of Redundant Equipment

Alternate or redundant means of performing a critical function shall be separated physically by the maximum

3.1.2.1.2 Failure Deterrent and Detection (cont'd)

practical distance, or otherwise protected, such that all functional paths will not be lost due to a single event.

b) Transient Caused Failures

The galley subsystem shall be designed such that transient out of tolerance conditions or component failures will not cause other component/subsystem failures.

c) Protection of Redundant Components

Redundant components susceptible to similar environmental failure causes such as shock, vibration, acceleration, or heat loads shall be physically oriented or separated to reduce the chance of multiple failure from the same cause(s).

d) Inadvertent Cross Connection

Where similar connections are in close physical proximity, the design shall preclude the capability of cross-connection.

e) Securing Threaded Parts

Threaded parts and fasteners shall be positively locked to prevent loosening during service.

f) Fatigue Failure

Flexible line sections shall be designed to preclude possible fatigue failures resulting from flow induced vibrations.

3.1.2.1.2 Failure Deterrent and Detection (cont'd)

g) Redundancy Verification

Each path or redundant subsystem shall be capable of verification of operational status during flight. During ground turnaround, operability of all redundancies shall be capable of being verified.

h) Checkout Point Connections

Electrical and fluid ground checkout test points will permit normal planned subsystem checkout to be made without disconnecting tubing or electrical connectors normally connected in flight.

i) Dead End Passages

Fluid subsystems shall not incorporate dead end passages or piping which could cause subsystem failures due to contamination buildup or corrosion.

j) Joining Techniques

Tubings and fittings shall be joined by brazing, welding or some other equivalent permanent joining technique, except where mechanical disconnects are required for replacement and servicing, or where components would be adversely affected by the joining technique.

k) Contamination Generation

Fluid subsystem elements shall be of a type which produces minimum contaminants which could potentially cause performance deterioration or failures by wear mechanisms or material incompatibilities.

3.1.2.1.2 Failure Deterrent and Detection (cont'd)

1) Inadvertent Electrical Shorting Due to Debris

Malfunction or inadvertent operation of electrical or electronic equipment caused by exposure to conducting or non-conducting debris, foreign material, or fluids floating in a gravity free state shall be prevented by design.

m) Gravity Sensitive Components

Gravity sensitive components (e.g., lightly spring-loaded check valves, scavaging type water separators, etc.) which are required to function in earth gravity, must be oriented to neutralize gravity effects in the vertical and horizontal (vehicle) modes. If hardware packaging cannot satisfy the above orientation requirement, the gravity sensitive components will not be used.

n) Vibration Sensitive Components

Solid state switches and amplifiers shall be given preference over electromechanical relays and other vibration-sensitive electrical/electronic parts in baseline design configurations consistent with range safety requirements. Sealed-type terminal blocks shall not be used.

3.1.2.2 Maintainability

Consideration shall be given in the design and construction of the Galley and its components to the ease of repair and maintenance of the field and during mission use.

3.1.2.2.1 Design Allocations

The design shall satisfy the following maintainability allocations.

a) The Galley when installed in the Orbiter shall be capable of being reloaded with food and expendables and verified as operational for relaunch by one man within one hour.

b) The galley subsystem shall have the capability in conjunction with Ground Support Equipment (GSE), if applicable, to isolate any discrepancy to the malfunctioning Line Replaceable Unit or onboard verification of LRU functional performance after installation in 0.75 hours.

c) Scheduled maintenance required for equipment shall be limited to replacement of time/cycle sensitive equipment.

d) The galley subsystem shall be designed to allow failed subassemblies to be replaced in 20 hours or less after failure identification.

e) LRU off-orbiter fault isolation, Shop Replaceable Unit removal/replacement and functional checkout of each LRU within 8.0 hours.

3.1.2.2.2 Design Features

The design shall incorporate the following maintainability features.

3.1.2.2.2.1 Maintenance

a) The galley subsystem design shall preclude the use of special tools and equipment for site maintenance, checkout,

3.1.2.2.2.1 Maintenance (cont'd)

and repair. Minimum manual dexterity shall be required for maintenance operations during prelaunch and the actual Space Shuttle mission.

b) The galley subsystem shall be designed to satisfy the requirements of an LRU.

c) LRU's shall be designed so that routine corrective maintenance can be accomplished at the shop level of maintenance. Repair of LRU's shall be accomplished by the replacement of Shop Replaceable Units (SRU's).

d) SRU's shall be designed so that maintenance actions not requiring extensive refabrication, refurbishment, or overhaul can be accomplished at the shop level of maintenance. Corrective maintenance of SRU's shall be designed to preclude the loss or dropping of hardware which could cause internal damage or affect the LRU's serviceability or increase maintenance time.

e) Scheduled maintenance of the galley subsystem when in its installed configuration shall be limited to the maintenance and repair areas.

f) The necessity for any maintenance servicing or checkout tasks, other than built-in test capability, to be accomplished during flight is prohibited.

3.1.2.2.2.1 Maintenance (cont'd)

g) No on-vehicle adjustments or calibration shall be permitted except as identified elsewhere in this specification.

h) Suitable warnings shall be provided on instruction plates or service placards if hazardous conditions exist when maintenance is performed.

i) Capability for purging/flushing of fluid system LRU's while installed shall be provided. Components which cannot be designed to satisfy this requirement shall be identified and shall use quick disconnect interfaces to allow local flushing or removal for flushing at an intermediate level facility.

j) Standard torque values shall be used for fittings, fasteners, and threaded fasteners used on/in the orbiter that require torquing.

k) The galley subsystem design shall not require pre-installation acceptance checkout prior to use.

l) The galley subsystem shall be designed so as to preclude the need for on-line support equipment.

3.1.2.2.2.2 Installation

a) The equipment design shall physically prevent the incorrect installation of modules and sub-modules. Clearly visible color coding and labeling in close proximity to maintenance disconnect points shall be used to facilitate removal and replacement of any subassembly level of equipment.

3.1.2.2.2.2 Installation (cont'd)

b) Components shall be mounted in a manner to avoid blind adjustments.

c) Mechanical retention devices for equipment/components shall not require safety wiring.

d) Fluid and pneumatic interfaces to package installed LRU's shall incorporate disconnects operable without requiring special tools. Quick disconnects, when utilized, shall be self-sealing upon disconnect with no leakage while disconnected and self-purging when reconnected to prevent fluid loss and system contamination. Temperature sensor installations in fluid systems shall be designed in a manner to allow removal and replacement without fluid loss.

e) If a component is mounted and secured by bolts where the component must be held in place until the bolts are engaged, pilot keyhole mounting or similar installation aid shall be provided.

f) Thread fasteners used for securing a single component, where practical, shall be the same type, size, and tensile strength.

g) Assembly/subassembly installations shall be designed such that accessibility to threaded fasteners may be accomplished without the use of universal joints,

3.1.2.2.2.2 Installation (cont'd)

angular extensions, handle extensions, or combinations thereof, in conjunction with torque tools.

h) Captive fasteners shall be utilized to fasten LRU's.

i) The galley is to be removed for some shorter missions. Provisions shall be included in the design to allow access to and visual verification of attaching fasteners and electrical and water connections during removal and installation operations without requiring major disassembly of the galley.

3.1.2.2.2.3 Accessibility

a) The subsystem installation shall provide adequate personnel access to and tool clearance between LRU's. The removal of any LRU shall not require major removal of any other functional hardware, plumbing or wiring. Tubing and wire run protection shall be incorporated in traffic areas and wire bundle accessibility shall be provided without invalidating other wiring circuits or their related equipments.

b) Electrical connectors shall be accessible without disassembly or removal of functional equipment or components.

c) Servicing, test points and calibration controls shall be accessible and clearly marked for major functions.

d) All fasteners on a single access cover shall be of the same length, diameter and type.

3.1.2.2.2.4 Replacement

a) Mounting provisions shall permit SRU removal and replacement without disconnecting any equivalent level SRU in the line replaceable unit. If removal of a LRU structural element is required for access, such removal shall not affect electrical or mechanical alignment, nor shall the mechanical strength of the unit be impaired to the point that bending of the unit, its assemblies, electrical harnesses, or plumbing attachments, will occur during normal bench handling of the unit.

b) Interconnecting plumbing and wire runs shall be of suitable attachment, length, and mounting to facilitate LRU replacement. Attach fittings for components routinely removed shall be operable without hand tools and shall be accessible without requiring removal of access panels or covers.

3.1.2.2.2.5 Handling

a) Handling provisions shall be provided on LRU's in accordance with MIL-STD-1472.

b) All wiring harnesses shall be protected from handling damage. The protective considerations shall not inhibit repair or replacement of the wire harness.

3.1.2.3 Useful Life Requirements

The useful life of an item can be restricted by limited operating life, limited shelf life, operating life sensitivity, or combinations of these. The useful life of the galley is controlled by the

3.1.2.3 Useful Life Requirements (cont'd)

requirements of Paragraphs 3.1.2.3.1 and 3.1.2.3.2.

3.1.2.3.1 Shelf Life

A limited shelf life item is one that deteriorates with the passage of time and thus requires periodic replacement, refurbishment, retesting, or operation to assure that its operating characteristics have not degraded beyond acceptable limits. The subsystems of the galley shall be designed for a minimum shelf of four years.

3.1.2.3.2 Operational Life

Operational life is defined as the maximum operating time/cycles which an item can accrue before replacement or refurbishment without risk of performance degradation below acceptable limits. The operational life of the galley shall be a minimum of ten years. The galley shall be capable of performing the functions described in 3.1.1 above for a minimum of 100 orbital missions.

4.0 TESTS

4.1 Development Tests

4.1.1 Requirements

The seller shall perform development engineering evaluation of hardware, software, manufacturing processes, and techniques for the purpose of acquiring engineering data; identifying sensitive parameters; evaluating the development configuration; providing

4.1.1 Requirements (cont'd)

the necessary confidence that the hardware will meet the specification requirements; and assurance that the manufacturing process will produce an acceptable product.

Development objectives shall encompass the following as a minimum:

a) Design and performance capability, including redundancy.

b) Ability to meet specified requirements with adequate design margin.

c) Integration of each component and subsystem with other components, subsystems, facilities, support equipment, etc.

d) Establishment of process, procedures, equipment, and test levels for manufacturing acceptance testing, maintenance, checkout, and operational phases of the program.

e) Identification of significant failure mode and effects.

f) Determination of the effect of various combinations of tolerances and drift of design parameters.

g) Determination of the effect of combinations and sequences of environments and varying stress levels.

h) Identification of safety hazards, parameters, requirements, and procedures.

i) Determination of the optimum configuration of the galley with the aid of human subjects, to perform the food preparation function under zero gravity conditions.

4.1.2 Operating Limits on Temperature Controlled Equipment

The test program and appropriate analyses shall define:

a) The maximum and minimum temperature of the oven and hot water heater expected in normal operation.

b) The maximum and minimum temperature of the oven, hot water heater, and chilled water supply which will result in acceptable food temperatures as defined in 3.1.1.1.2.

4.2 Acceptance Test Requirements

Acceptance inspection and test shall be performed on all items to be employed in test programs and on items delivered to the buyer. The tests and inspections shall be performed in a manner and under conditions which simulate end-use to the highest degree practicable without damage to the units. The degree, duration, and number of tests shall be sufficient to verify that the quality required is present. The seller shall specify the tests and sequence subject to buyer approval.

TABLE I. Acceptance Tests

Requirements	Paragraphs Listed in Recommended Testing Sequence
Physical Inspection	3.2.1.1.3
Weight	3.3.1.1
Electrical Characteristics	3.2.1.1.5
Water System Interface	3.2.1.1.4
Water Dispenser	3.1.1.2.3.3
Factors of Safety	3.3.1.4

4.2.1 Examination of Product

Each galley component shall be carefully examined to determine conformance to the requirements of this specification. Particular attention shall be given to weight, workmanship, finish, dimensions, construction, cleanliness, identification, marking, traceability level, and that certified materials and processes have been used.

4.2.2. Functional and Performance Test

Functional and performance tests will be conducted by seller to establish compliance with the requirements of paragraph 3.1.1 subject to approval of buyer.

4.2.2.1 Acceptance Vibration Test (AVT)

Where manufacturing and workmanship defects cannot be detected by normal inspection techniques, the galley assemblies shall be subjected to an AVT. The random vibration for the AVT is described as follows:

Acceleration spectral density increasing at the rate of plus 3 db/octave from 20 Hz to 80 Hz; constant at .04 g^2/Hz to 350 Hz; decreasing at the rate of minus 3 db/octave from 350 Hz to 2000 Hz. The vibration test duration shall be adequate to perform functional or continuity checkouts, but shall not be less than 30 seconds or greater than one minute per axis. Should reruns be required in any axis, the total accumulative vibration test time in that axis shall not exceed five minutes. The galley assemblies shall be tested on

4.2.2.1 Acceptance Vibration Test (AVT) (cont'd)

the identical fixture used for the vibration qualification tests. The general requirements for vibration qualification tests shall also apply for acceptance vibration tests, except that tolerances shall be as specified in SP-T-0023. Selected functional tests (TBS) shall be conducted on all items before and after acceptance vibration tests. All electrical circuits shall be monitored for continuity during the vibration test to check for intermittents and opens.

4.2.2.2 Insulation Resistance Test

Insulation resistance tests shall be conducted in accordance with MF0004-002.

4.2.2.3 Dielectric Strength Test

The dielectric strength test shall be conducted in accordance with MF0004-002.

4.2.2.4 Proof Pressure

The galley components shall be subjected to a proof pressure test.

4.3 Certification Requirements

4.4 Verification Methods and Responsibility (Matrix)

The seller's verification program shall satisfy the performance and design requirements specified in Table II. Where a verification method is not indicated, the seller shall propose the method for verification of the requirement. Alternate verification approaches may be recommended by the seller.

VERIFICATION METHOD

1. Analysis
2. Assessment
   a) Inspection
   b) Review of Design

N/A - Not Applicable

3. Test
   a) Development
   b) Qualification
   c) Acceptance
   d) Vehicle Acceptance
   e) Pre-Flight Check Out
   f) Horizontal Flight
   g) Vertical Flight
   h) Major Ground Test

Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.1 Operational Req.						x							
3.1.1.1.1 Food Capacity				x									
3.1.1.1.2 Food Prep.					x		x						
3.1.1.1.3 Meal Assembly				x									
3.1.1.1.4 Work Area				x									
3.1.1.2.1.1 Food Primary Pkg.	x												
3.1.1.2.1.2 Food Qty & Wts.						x							
3.1.1.2.1.3 Food Accessibility						x							
3.1.1.2.2 Trays						x							
3.1.1.2.3 Water System							x						

(cont'd)

TABLE II
Verification Matrix

VERIFICATION METHOD

1. Analysis
2. Assessment
   a) Inspection
   b) Review of Design

N/A - Not Applicable

3. Test
   a) Development
   b) Qualification
   c) Acceptance
   d) Vehicle Acceptance
   e) Pre-Flight Check Out
   f) Horizontal Flight
   g) Vertical Flight
   h) Major Ground Test

Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.1.2.3.1 Flow Demand	x												
3.1.1.2.3.2 Water Heater							x						
3.1.1.2.3.3 Water Dispenser					x	x							
3.1.1.2.4 Oven						x							
3.1.1.2.4.1 Oven Pre-Heat							x						
3.1.1.2.4.2 Controls							x						
3.1.1.2.4.3 Instrumentation							x						
3.1.1.2.4.4 External Temp.		x											
3.1.1.2.5 Utensils			x										
3.1.1.2.6.1 Waste Storage				x									

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

1. Analysis
2. Assessment
   a) Inspection
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N/A - Not Applicable

3. Test
   a) Development
   b) Qualification
   c) Acceptance
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   f) Horizontal Flight
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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.1.2.6.2 Waste Stabil.				x									
3.1.1.2.7 Wipes				x									
3.1.1.2.7.1 Personal Wipes				x									
3.1.1.2.7.2 Galley Wipes				x									
3.1.1.2.8 Elec. Pwr. Char.						x							
3.1.1.2.9 Instrumentation				x									
3.1.2 Operability Req.	x												
3.1.2.1 Reliability				x									
3.1.2.1.1 Redundancy				x		x							
3.1.2.1.2 Failure Deterrent & Detection				x									

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.2.2 Maintainability				x									
3.1.2.2.1 Design Allocation								x					
3.1.2.2.2 Design Features	x												
3.1.2.2.2.1 Maintenance				x									
3.1.2.2.2.2 Installation				x									
3.1.2.2.2.3 Accessibility			x					x					
3.1.2.2.2.4 Replacement			x					x					
3.1.2.2.2.5 Handling			x	x									
3.1.2.3 Useful Life Req.	x												
3.1.2.3.1 Shelf Life						x							

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.2.3.2 Operational Life						x							
3.1.2.3.3 Limited Life Items		x											
3.1.2.4 Natural Environ.	x												
3.1.2.4.1.1 Pressure		x											
3.1.2.4.1.2 Fungus		x											
3.1.2.4.1.3 Humidity		x											
3.1.2.4.1.4 Lightning						x							
3.1.2.4.1.5 Ozone		x											
3.1.2.5 Induced Environ.	x												
3.1.2.5.1.1 Shock						x							

TABLE II
Verification Matrix
(cont'd)

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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.2.5.1.2 Pressure		x											
3.1.2.5.1.3 Temperature						x							
3.1.2.5.1.4 Humidity & Salinity						x							
3.1.2.5.1.5 Random Vibration		x											
3.1.2.5.1.6 Temperature		x											
3.1.2.5.1.7 Acceleration		x											
3.1.2.5.1.8 Acc. Thermal-Vac	x												
3.1.2.5.2 Flight Environ.	x												

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.2.5.2.1 Shock a		x											
b1		x											
b2						x							
b3		x											
b4						x							
3.1.2.5.2.2 Acceleration						x							
3.1.2.5.2.3 Struc. Vibration						x							
3.1.2.5.2.4 Temperature		x											
3.1.2.5.2.5 Pressure		x											
3.1.2.5.2.6 Humidity & Salin.		x											
3.1.2.6 Transport & Storage	x												
3.1.2.6.1 Nat. Environ. Transport.	x												

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.1.2.6.1.1 Temperature						x							
3.1.2.6.1.3 to 3.1.2.6.1.12		x											
3.1.2.6.2 Natural Environ. Storage		x											
3.1.2.6.3 Induced Environ. Transport		x											
3.1.2.6.4 Induced Environ. Storage		x											
3.1.2.7 Human Factors				x									
3.1.2.8 Safety				x									
3.2.1.1.1 Installn. Location			x										

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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3. Test
   a) Development
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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.2.1.1.2 Restrictions on Instalin & Removal				x				x					
3.2.1.1.3 Struc. Interface								x					
3.2.1.1.4 Water System Interface								x					
3.2.1.1.5 Elec. Interface								x					
3.2.1.2 Food Interface					x								
3.2.1.3 Flight Crew					x								
3.2.1.4 Mission Interface				x									
3.2.1.5 GSE Interface	x												
3.2.2 Training Hardware Interfaces	x												

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Seller Conducted

Buyer Conducted

Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
3.3.1.1 Weight			x										
3.3.1.2 Center of Gravity		x	x										
3.3.1.3 Config. & Envelope			x										
3.3.1.4 Factors of Safety							x						
3.3.1.5 Decompression				x									
3.3.1.6 Mech. Locks				x									
3.3.1.7 Displays & Controls				x									
5.0 Prep. for Delivery	x												
5.1 General	x												

TABLE II
Verification Matrix
(cont'd)

VERIFICATION METHOD

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Section 3 and 5 Requirement Number	Verification Method												Section 4 Requirement Number
	N/A	1	2		3								
			a	b	a	b	c	d	e	f	g	h	
5.2 Packaging, Handling & Transport	x												
5.2.1 Preservation & Packaging				x									
5.2.2 Packing				x									
5.2.3 Design Req.		x											
5.2.4 Reusable Cont.				x									
5.2.5 Monitoring Devices				x									
5.2.6 Temp. Hardware			x										
5.2.7 Packing & Test	x												
5.2.8 Marking for Ship.			x										

TABLE II
Verification Matrix

5.0 PREPARATION FOR DELIVERY

5.1 General

The requirements specified herein govern the preparation for shipment and the transport of the galley to all buyer and government facilities. The methods of preservation, packaging and packing utilized for shipment together with necessary special control during transportation shall adequately protect the galley from damage or degradation of performance due to the natural and included environments encountered during transportation and subsequent storage as specified herein.

5.2 Packaging, Handling and Transport

Packaging, handling, and transportation shall be in accordance with applicable requirements and guidelines of NHB6000.1(1A) as supplemented by the following subparagraphs.

5.2.1 Preservation and Packaging

Preservation and packaging shall be in accordance with the requirements of Level A of MIL-STD-794.

5.2.2 Packing

Packing shall be in accordance with the requirements of Level B of MIL-STD-794.

5.2.3 Design Requirement (Structural)

Preservation, packaging, and packing shall be designed to withstand the rough handling package requirements of MIL-STD-794 as defined

5.2.3 Design Requirement (Structural) (Cont'd)

in FED-STD-101 (without damage or degradation to the useful life or performance of the contained item and without damage to the preservation, packaging, and packing which would affect their utility) in accordance with the following:

FED-STD-101 Method

5007 Procedure B Free Fall Flat Drop (Level A)
5007 Procedure E Free Fall Corner Drop (Level A)
5017 Superimposed Load (without Dunnage Level A)
5019 Vibration (Repetitive Shock)
5020 Sinusoidal Vibration

5.2.4 Reusable Containers

Where analysis in accordance with NHB6000.1(1A) indicates a requirement for reusable containers, maximum practical utilization shall be made of standard off-the-shelf, low cost metal or plastic containers.

5.2.5 Monitoring Devices

MIL-I-26860 humidity indicators shall be installed in the container wall, or flexible barrier wall, of all Method II (desiccation) packages. Utilization of additional instrumentation for monitoring or recording other in-transit environments (e.g., shock, vibration, temperature, etc.) shall be approved by the buyer prior to implementation.

5.2.6 Temporarily Installed Hardware Identification

All temporarily installed devices such as caps, plugs, covers, support bracketry, protective plates, etc., shall be cerise red in color or shall have attached cerise red colored streamers to ensure that they are easily identified under casual observation.

5.2.7 Pre-Production Packaging Qualification Tests

Testing to verify the functional capability of the package or transport methods/equipment shall be accomplished as required by Section 4 of this specification.

5.2.8 Marking for Shipment

Interior and exterior containers shall be marked and labeled in accordance with MIL-STD-129 including precautionary markings necessary to ensure safety of personnel and facilities and to ensure safe handling, transport, and storage. Packages with reuse capability shall be identified with the words "REUSABLE CONTAINER - DO NOT DESTROY - RETAIN FOR REUSE". NASA Critical Item Labels (Form 1386 series) shall be applied in accordance with NHB6000.1(1A). Identification information on interior and exterior containers shall be in the following format and shall include:

BUYER CONTROL NUMBER _____

ITEM NAME _____

FSN/NATO STOCK NUMBER _____ (WHEN APPLICABLE) _____

MANUFACTURER'S TYPE OR PART NUMBER _____

QUANTITY IN PACKAGE _____ TRACEABILITY IDENTIFICATION _____

AGE CONTROL MARKING _____

CLEANING MARKING _____ (NOT APPLICABLE) _____

SERIAL NUMBER _____

MANUFACTURER _____

BUYER PURCHASE ORDER NUMBER _____

DATE OF PACKAGING _____

LEVELS OF PACKAGING AND PACKING _____

MANUFACTURER'S PACKAGE PART NUMBER _____ (NOT REQUIRED FOR OFF-THE-SHELF CONTAINERS)